A NEW SPECIES OF *DODECATHEON* (PRIMULACEAE) FROM THE NORTHERN COAST RANGE OF OREGON AND WASHINGTON

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ABSTRACT

Dodecatheon austrofrigidum is described as a species occupying scattered sites in the Coast Ranges of northwestern Oregon and adjacent Washington, U.S.A. It is similar in floral morphology to, but widely disjunct from, *D. frigidum*, a species of the interior mountains and arctic tundra of Alaska and northern British Columbia. It also is ecologically distinct, being associated with streams, waterfalls, cliffs, rocky river banks, and high elevation moist grassland and basalt talus slopes in a maritime climatic zone. Its relationships are with members of Sect. Dodecatheon, but its seedling morphology is different from any described thus far in the genus. Morphology of the seed testa is illustrated by scanning electron microscopy.

RESUMEN

Dodecatheon austrofrigidum se describe como una especie que ocupa lugares espaciados de la Cordillera Costera del Noroeste de Oregon y de Washington, U.S.A. Es similar en la morfología floral, pero muy disyunta de, *D. frigidum*, una especie de las montañas interiores y la tundra ártica de Alaska y norte de British Columbia. También es ecológicamente diferente, estando asociada a arroyos, cascadas, acantilados, lechos rocosos de ríos, y praderas húmedas a gran altitud y laderas basálticas en una zona climática marina. Está relacionada con los miembros de la Sect. Dodecatheon, pero la morfología de sus plántulas es diferente de cualquiera de las hasta ahora descritas en el género. Se ilustra la morfología de testa seminal al microscopio electrónico de barrido.

INTRODUCTION

The northern Coast Ranges of Oregon and immediately adjacent Washington, especially on the higher peaks, are known to harbor a small suite of endemic plant species. Prominent in this list are *Cardamine pattersonii* L.F. Hend., *Castilleja chambersii* M. Eggers & R. Meinke, *Erythronium elegans* P. Hammond & K.L. Chambers, *Filipendula occidentalis* (Wats.) Howell, and *Saxifraga hitchcockiana* Elvander. A floristic affinity to the Olympic Mountains and coastal Alaska is suggested by more northern taxa whose ranges extend south to this region. These include *Carex macrochaeta* C.A. Mey., *Cladothamnus pyroliflorus* Bong., *Erigeron peregrinus* (Pursh) Greene var. *peregrinus*, *Lewisia columbiana* var. *rupicola* (English) C.L. Hitchc., *Prenanthes alata* (Hook.) Dietr., *Saxifraga caespitosa* var. *emarginata* (Small) Rosend., *Senecio flettii* Wieg., and

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Synthyris schizantha Piper (Chambers 1973, 1974). Saddle Mountain, Clatsop County, Oregon, is a well known botanical site where many of these species have been found (Detling 1954).

Also known from Saddle Mountain, near the 1000m summit, is a dwarfed form of *Dodecatheon*, which the monographer, H.J. Thompson (1953, p. 118) referred, with some hesitation, to *D. pulchellum* (Raf.) Merrill (his *D. radicatum* Greene). A number of years ago I was directed to populations of vigorously growing examples of this plant along the Trask River, Tillamook County, Oregon, which I brought into cultivation. This tentative new species was then made known to interested botanists under the name *Dodecatheon austrofrigidum*, which has now come into general use for the plant. I here provide a description and further documentation of this species.

Dodecatheon austrofrigidum K.L. Chambers, sp. nov. (**Figs. 1, 2**) TYPE: U.S.A. OREGON. Tillamook Co.: Trask River Rd., 6.1 mi E of junction with Long Prairie Rd., T1S, R8W, S28, elev. ca. 200 ft, in patches of moss on bare, sloping rocky bank of the Trask River, between low and high water marks, with *Saxifraga nuttallii*, *S. mertensiana*, *Mimulus guttatus*, 13 May 1989, *K.L Chambers 5436* (HOLOTYPE: OSC; ISOTYPES: FSU, G, MARY, MO, NY, OSC, UC, US, WS, WTU).

Planta ad *Dodecatheon frigidum* et *D. dentatum* similis foliis variis glabris calyce glabro dentibus triangularibus acutis lobis corollae lavandulis tubo corollae albo filamentis fere liberis connectivis antherarum purpureis laevibus stigmate non capitato ab *D. frigido* radicibus numerosis fibrosis validis caudice plerumque per annos paucos persistenti differt, ab *D. dentato* corolla lavandula non alba differt; chromosomatum numerus $2n = 88$.

Perennial herb; **roots** numerous, stout, fibrous, often producing adventitious buds; **caudex** usually short-lived, with subsequent years' vegetative growth arising from a terminal bud or from small buds on the roots; **leaves** in a basal rosette, glabrous, variable, 2.5–30 cm long, 0.7–7 cm wide, ovate to broadly or narrowly elliptic, gradually or abruptly tapering to the petiole, margins entire to irregularly sinuate-dentate or denticulate; flowering **stems** scapose, 5.5–45 cm high; **inflorescence** a bracteate umbel of 1–7 pedicelled flowers, bracts 2.5–10 mm long, pedicels 4–55 mm long, glabrous to glandular-puberulent, especially distally; **calyx** 5–11 mm, tube 1–2.5 mm, lobes 3–9 mm, triangular, acute; **corolla** lobes 9–23 mm long, 2–6 mm wide, lavender, tube 1–2 mm long, white with a sinuous purple line where reflexed; **anthers** purple, 4.5–8 mm long, filaments 0.5–1 mm, free or slightly united, purple, connective smooth, purple; **style** exserted, stigma not capitate; **capsule** 6–16 mm long, 3.5–5.5(–7) mm wide, teeth ca. 1/5 of total length, dehiscence operculate or valvate; **seeds** 1–2 mm, irregularly rounded or prismatic, foveolate (Fig. 2); **seedlings** with petiolate cotyledons, the first principal adult root produced adventitiously from the apex of the hypocotyl, the first true leaf petiolate, arising between the cotyledons (Fig. 3). The chromosome number is tetraploid on the base of $x = 22$ characteristic of the genus.

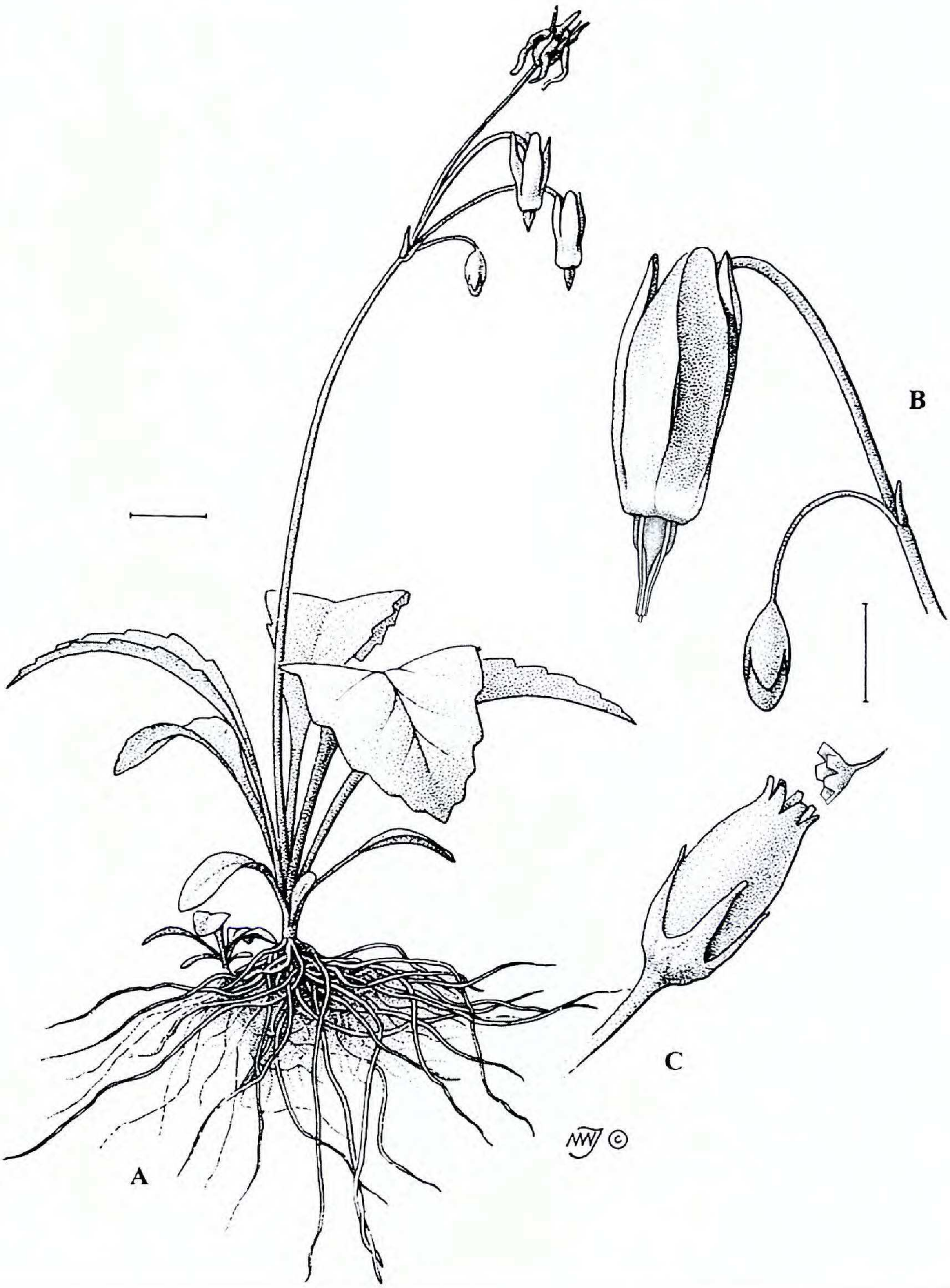

FIG. 1. *Dodecatheon austrofrigidum* K.L. Chambers. **A.** Habit. Scale=2 cm. **B.** Flower. Scale=7 mm. **C.** Capsule with operculum. Scale=7 mm.

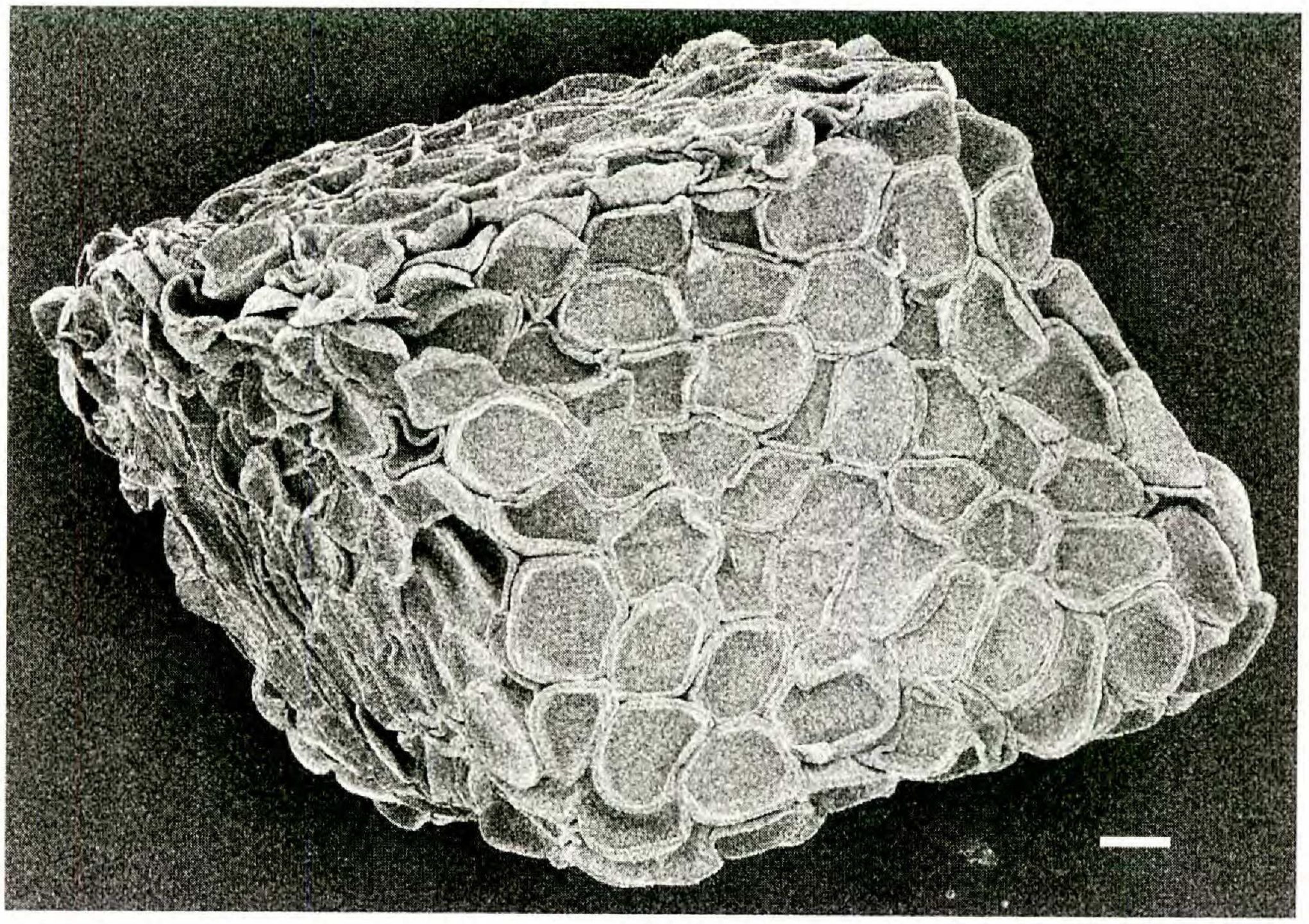

FIG. 2. Seed. Scale=0.1 mm.

Distribution.–Ranging from 30–1200 m, at scattered sites from the southern Olympic Mountains, WA (Mt. Colonel Bob) to Tillamook County, OR, both at high elevations in moist, grassy turf (Saddle Mountain and Onion Peak, Clatsop Co., OR) and in forested regions, where the habitats include moist basaltic slopes, talus, and cliff-faces, especially near waterfalls and streamlets. Further populations occur at low elevations in Tillamook Co., on bare or mossy basalt rock banks of rivers, between the low- and high-water marks, in the winter flood-scour zone (Raven 1995, 1996). Plants in this peculiar habitat probably become established by seeds washed down from the mountain populations, and their tenacious mass of strong roots, penetrating crevices in the rock, anchors them from being washed away during the period of winter flooding. The species is allopatric in range to all other members of the genus.

Flowering.—April–July, depending on habitat and elevation. Flowers are self-fertile and capable of self-pollination in cultivation.

Relationship.—Thompson (1953) recognized three sections within the genus, differentiated by characteristics of the stigmas, capsules, seeds, and seedlings. The new species is best assigned to Sect. Dodecatheon, with the proviso that *D. frigidum* Cham. & Schltdl. should also be placed in this section, rather than Sect. Purpureo-tubulosa of Thompson. The corrected placement is strongly supported by molecular evidence provided by Mast et al. (2004) and by the

marked floral similarity between *D. frigidum* and *D. austrofrigidum*. Mast et al. (2004) show a strict consensus tree based on seven cpDNA regions, in which *D. frigidum* is sister to the group of other taxa in Sect. Dodecatheon, rather than forming a clade with *D. conjugens* Greene in Sect. Purpureo-tubulosa, as proposed by Thompson. In this DNA-based phylogeny, *D. austrofrigidum* is paired in Sect. Dodecatheon with *D. dentatum* Hook. ssp. *utahense* (N. Holmgren) Kartesz (perhaps itself a distinct species).

Dodecatheon austrofrigidum differs in two significant features from the morphological characterization of Sect. Dodecatheon given by Thompson (1953). These, and an improved knowledge of the seed testa based on SEM studies (Fig. 2), will be discussed in turn. Most important, I believe, is that seedling morphology and development are distinctly different than had been described for this section. In *D. austrofrigidum*, the seed begins with two petiolate cotyledons (as Thompson, 1953, Fig. 1g, illustrates for *D. pulchellum*). The first true leaf, itself petiolate, next arises from between these cotyledons. Finally, a strong, major adult root forms adventitiously at the base of this first true leaf, between the cotyledons, replacing the seedling's initial but ephemeral root system (Fig. 3). In the seedling of *D. pulchellum* (*D. radicatum*) illustrated by Thompson (loc. cit.), the first true leaf is linear-spatulate, not petiolate, and arises adventitiously from the hypocotyl well below the cotyledons; the new adventitious major root grows downward from that same point on the hypocotyl. Neither of the other two seedling types illustrated by Thompson (loc. cit.) resembles that of *D. austrofrigidum*.

The mature capsules of *D. austrofrigidum* differ in their dehiscence mode from that described for Sect. Dodecatheon (Thompson, op. cit., p. 79). The section is characterized as having valvate capsules, but in *D. austrofrigidum*, they are most often operculate instead. Capsules are thin-walled below and have an indurate apex where the cells are thick-walled and isodiametric. As these cells dry at maturity and shrink, tensions develop that rupture the tissue and open the capsule for seed dispersal (Fig. 1C). A transverse rupture through the tip region causes an operculum to free itself, carrying with it the dried style. Usually five lengthwise splits also occur at the same time, but some of the five teeth thus formed may in turn split in half, so that dehisced capsules may be found with up to ten teeth. In a sample of 181 capsules, the average number of teeth was 6.28, the numbers of capsules with 5, 6, and 7 teeth being approximately equal. The initial five splits can often be observed in the operculum (Fig. 1C). Valvate dehiscence, where the lengthwise splits reach the apex, is usually noted in smaller, less robust capsules.

Seeds of *D. austrofrigidum* (Fig. 2) conform to the description of Sect. Dodecatheon (Thompson op. cit., p.75–76). They are irregular in shape but often flattened on two or more sides, becoming even more prismatic than in Thompson's drawing (op. cit., Fig. 1f). They do not resemble the membranous-

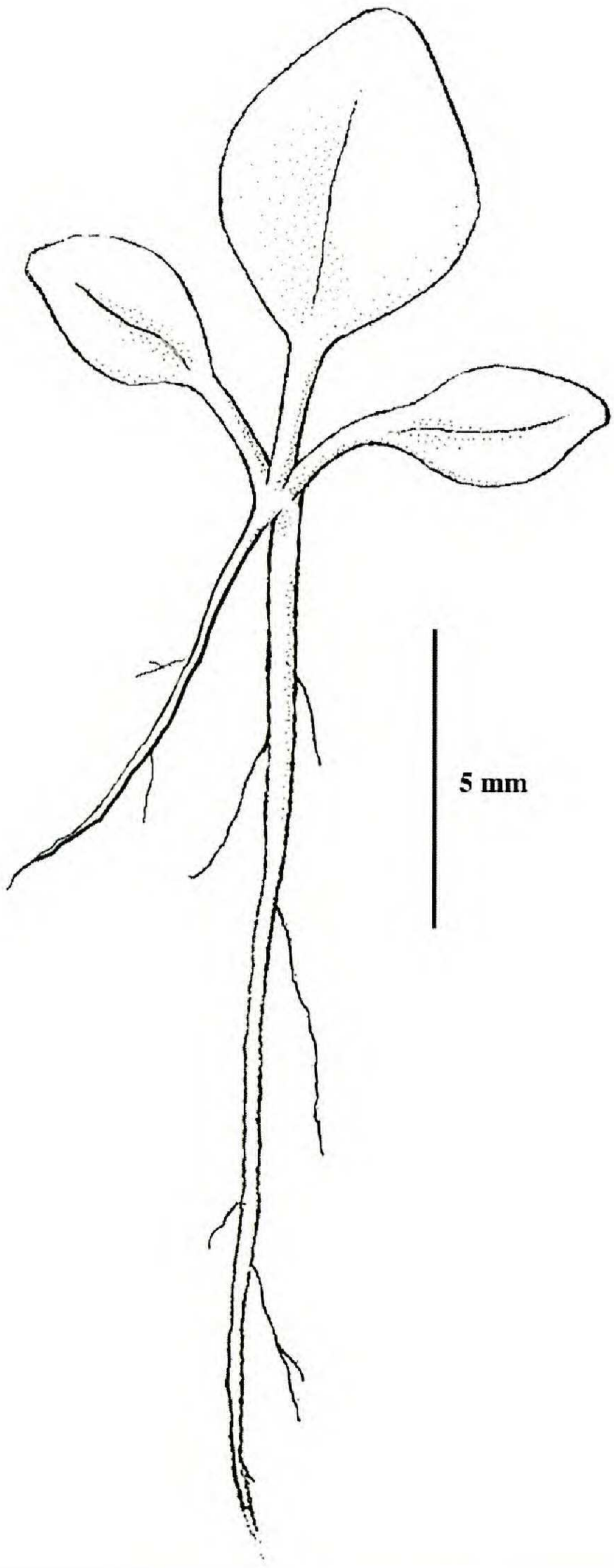

FIG. 3. Seedling, showing petiolate cotyledons and first leaf. A major adventitious root, right, replaces the initial, short-lived seedling hypocotyl and root at the left. Scale=5 mm.

margined seeds of Sect. Capitulum (Thompson loc. cit.). The testa is formed initially of tightly packed bulbous cells, which at maturity deflate into irregular, rimmed, dish-shaped foveae (Fig. 2), best visualized by SEM. In view of these newly published observations on *D. austrofrigidum*, it is likely that a survey of

seed, seedling, and capsular morphology in all the species will contribute to an improved understanding of intrageneric relationships.

Cited collections: **U.S.A. OREGON. Clatsop Co.:** Onion Peak, elev. 3064 ft, T4N, R10W, S22, 29 Jun 1971, *Chambers 3169* (CAS, OSC); same, 21 Jul 1971, *Chambers 3258* (OSC); Saddle Mtn, T6N, R8W, S33, 29 May 1972, *D. Jaques 973* (OSC); same, elev. 2600 ft, T6N, R8W, S19, 24 May 1950, *Detling 6550* (CAS, ORE, UC); Saddle Mtn, elev. 3200 ft, 10 Jun 1928, *G. R. Patterson s.n.* (ORE). **Tillamook Co.:** Trask River Rd. at 9.5 mile marker, on basalt bank of Trask R., 29 Jun 1980, *Chambers 4694* (OSC); same, 10 Jun 1979, *G. Lewis s.n.* (OSC); Standard Grade Rd. above Elk Ck., elev. ca. 3200 ft, T2N, R7W, S13, photo, Jun 1981, *G. Lewis s.n.* (OSC); near Diamond Falls, Tillamook State Forest, elev. 1480 ft, T2N, R9W, S32, 13 Jun 2001, *Chambers 6300* (OSC); Kilchis Falls, Tillamook State Forest, elev. 1540 ft, T1N, R8W, S3, 13 Jun 2001, *Chambers 6299* (OSC). **WASHINGTON. Grays Harbor Co.:** Mt Colonel Bob, above Moonshine Flats, elev. 3800 ft, T23N, R8W, S18, 20 Jul 1983, *E. Alverson 590* (OSC); same, 6 Jul 1994, *D. Davis s.n.* (OSC). **Pacific Co.:** Willapa Hills, headwaters of West Fork of Grays R., elev. 1500 ft, T11N, R7W, S10, 12 Apr 1994, *J. Powell 1324* (OSC); same, elev. 1800 ft, 23 Apr 1995, *J. Powell 1410* (OSC).

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